

Smart Refrigerator Using IOT

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Abstract: Intelligent appliances with multimedia capability have been emerging into our daily life. Thanks to the fast advance of computing technology and the wide use of the Internet, smart home is one of the most prominent areas of intelligent appliances. Kitchen is one of the places where such intelligent appliances have been used. The products currently available are expensive as the user has to purchase the whole refrigerator. The Smart Refrigerator module is designed to convert any existing refrigerator into an intelligent cost effective appliance using sensors. In previously established system according to the available contents in the fridge the recipe is shown on LCD. Our refrigerator is capable of sensing and monitoring its contents and the refrigerator is also able to remotely notify the user about scarce products via android application. It also facilitates the purchase of scarce items by providing a link of the online vendor of that particular item.

1. INTRODUCTION

The paradigm of the Internet of Things (IOT) requires pervasive connectivity to billions of heterogeneous devices. In recent time, rapid growth of IOT devices in smart home environment envisioned a wide range of novel services and applications. Kitchen is one of the most important place for a Smart home as it consists of many Appliances which provides better services to the household. The focus of our project is on the smart fridge. Many efforts in the development of the smart refrigerator have been made, none of which has been energy efficient or cost effective. The modern living and the fast paced environment doesn't allow the user to keep a track of the food items inside the refrigerator.

Although efforts have been put by the industry to develop the smart refrigerator, the current or the existing technology is still not cost effective or energy efficient. The technology is too complicated or complex for a simple household user who have little knowledge of how all the mechanism behind the smart refrigerator works. The internet connectivity at most of the places is still poor and there is limited network connectivity i.e. either low internet speeds or low support. The barcode is not uniform to record the essentials of the product that includes the expiration date. The smart home environment or the networked home doesn't have enough security to protect the outflow of data from the house. The privacy of user and the house can be compromised by attackers. There is no unique operating system for remote device use to control the smart system. There is no standard for the area, resulting products conforming to different specifications by different producers. The smart refrigerator or the internet refrigerator as it is called, is used to monitor the items inside it and notify about scarce products. Saving energy when possible, Providing ON-OFF control through mobile phone etc. The idea of connecting home appliances to the internet or the smart home environment has been seen as the future and is highly regarded as the next big thing.

2. History of Internet of Thing(IOT):

The concept of a network of smart devices was discussed as early as 1982, with a modified Coke machine at Carnegie Mellon University becoming the first internet-connected appliance, able to report its inventory and whether newly loaded drinks were cold. [4] The concept of the internet of things first became popular in 1999, through the Auto-ID Center at MIT and related market analysis publications. Radio-frequency identification (RFID) was seen by Kevin Ashton (one of the founders of the original Auto-ID Center) as a prerequisite for the internet of things at that point. If all objects and people in daily life were equipped with identifiers, computers could manage and inventory them. Besides using RFID, the tagging of things may be achieved through such technologies as near field communication. [1]

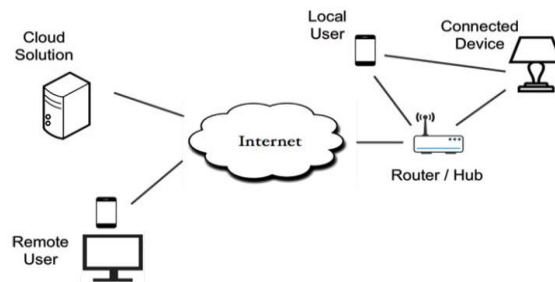


Figure:IOT Architecture

As of 2013, the vision of the internet of things has evolved due to a convergence of multiple technologies, ranging from wireless communication to the Internet and from embedded systems to micro-electromechanical systems (MEMS). This means that the traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the internet of things(IoT).

2.1 TIME SERIES:

1999: The term Internet of Things is coined by Kevin Ashton, Executive Director of the Auto-ID Center in Massachusetts Institute of Technology (MIT).

1999: Neil Gershenfeld first time spoken about IoT principles in his book titled “When Things Start to Think”.

1999: MIT Auto-ID Lab, originally founded by Kevin Ashton, David Brock and Sanjay Sarma in this year. They helped to develop the Electronic Product Code.

2000: LG announced its first Internet of refrigerator plans.

2002: The Ambient Orb created by David Rose and others in a spin-off from the MIT Media Lab is released into wild with NY Times Magazine naming it as one of the Ideas of Year.

(2003-2004): RFID is deployed on a massive scale by the US Department of Defence in their Savi program and Wal-Mart in the commercial world.

2005: The UN’s International Telecommunications Union (ITU) published its first report on the Internet of Things topic.

2008: Recognition by the EU and the First European IoT conference is held.

2008: A group of companies launched the IPSO Alliance to promote the use of IP in networks of “Smart Objects” and to enable the Internet of Things.

2008: US National Intelligence Council listed the IoT as one of the 6 “Disruptive Civil Technologies” with potential impacts on US interests out to 2025.

3. Literature survey:

INTERNET refrigerator also known as Smart refrigerator is a refrigerator which has been programmed to sense what kinds of products are being stored inside it and keep a track of the stock through barcode or RFID scanning. This kind of refrigerator is often equipped to automatically determine when a food item needs to be replenished. It also provides users with extra information about their products, their nutritional facts and consumption history. An internet refrigerator can download recipes based on its content; communicate with a microwave oven to prepare the cooking power and time for the given mix of ingredients. It can suggest drinks based on what is stored inside, the ambient temperature and the time of the day. [1] The first refrigerator connected to the Internet called Quantified Fridge was in a wired 100-year-old house in the Netherlands by Alex van Es in July 12, 1998; where it existed alongside networked lights, doorbell, mailbox, and, a toilet. [6] There is a record and broadcast every time the fridge door opens. As of this writing, almost 16 years after inception; it has been opened for almost 70,000 times. In 1999, Electrolux Screen fridge, a connected refrigerator designed to allow users to order groceries over the Internet but the product has yet to ship- was unveiled. [3] In 2000, Whirlpool/Cisco refrigerator which allow users to watch a celebrity chef on the Web pad was launched. It has an integrated Web-browser to search for recipes that match the food items people have on hand. In 2002, the Whirlpool's refrigerator transforms into a multimedia communications centre such that the owner can surf the Internet, receive emails, listen to the radio, watch TV, video and DVDs and even talk on the phone. [1]

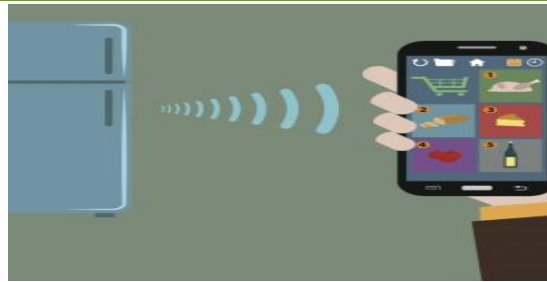


Fig.: data transmission of refrigerator to mobile

By the late 1990s and the early 2000s, the idea of connecting home appliances to the internet (Internet of Things) had been popularized and was seen as the next big thing. In June 2000, LG launched the world's first internet refrigerator, the Internet Digital DIOS. Internet refrigerator (also known as Smart refrigerator) is a refrigerator which has been programmed to sense what kinds of products are being stored inside it and keep a track of the stock through barcode or RFID scanning. [1] This kind of refrigerator is often equipped to determine itself whenever a food item needs to be replenished. This refrigerator was an unsuccessful product because the consumers had seen it as an unnecessary product and due to the high cost (more than \$20,000) and that the problems solved were obscure. For example, many juice bottles are transparent, providing a visual reminder that a purchase is needed eventually; vegetable drawers are similarly transparent and contain items often removed from packages, thus eliminating bar codes for inventory which meant manually keying in descriptions and dates. Moreover, the ability of the device to remind users of upcoming purchases when there are often multiple buyers in a household who communicate informally is not typically addressable as a use case. [4]

4. METHODOLOGY:

The system comprises of minimum four sections where the sensors are placed Proximity sensors are placed along with a counter which can be used to sense the number of eggs inside the refrigerator, also they are used to detect the level of milk and soft drinks in the container. The fourth application is to sense the presence of vegetables in the refrigerator which is being done with the help of pressure sensors which has a threshold of 500gm approximately. Whenever the contents inside the refrigerator goes below the set threshold it generates a trigger which is being transmitted in the form of message to the user. The another application is to check whether ice is ready, and give indication on front panel of refrigerator. This system is based on Internet of Things so all the data from the sensors is provided to microcontroller and through microcontroller it will be placed on the cloud through Wi-Fi chip interfaced to the controller. User will have android app which will download data from cloud so as the user can monitor contents as well as he/she can control the refrigerator remotely through internet.

SENSORS: These field sensors are fitted in Refrigerator where bottles are stored, one for each bottle. They are object sensors and if not found any object in front of them, they produce NO Object signal which is fed to Object Detector Unit for further processing.

OBJECT DETECTOR UNIT: This unit generates NO Object alert signal corresponding to field sensors signal, which is server's software format. This server understandable alert signal is fed to input port of server through suitable Interfacing stage.

INTERFACING STAGE: As server needs TTL compatible level signals at its input port, suitable interfacing stage must be introduced before feeding field signals directly to it to avoid any kind of damage.

Sensors used in Smart Refrigerator:

Temperature sensor: It is used to measuring the temperature in main compartment and freezer. Also used to compare the room temperature to auto-off the refrigerator.

Gas sensor: A gas detector is a device that detects the presence of gases in an area, often as part of a safety system. This type of equipment is used to detect a gases produced by vegetables. Gas detectors can be used to detect combustible, flammable and toxic gases.

Proximity sensor: A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact. In smart refrigerator these sensors are used to detect the absence of eggs or any regular items.

4) **Load cell:** Over weighting detection in compartment of refrigerator can be detected using load cell.

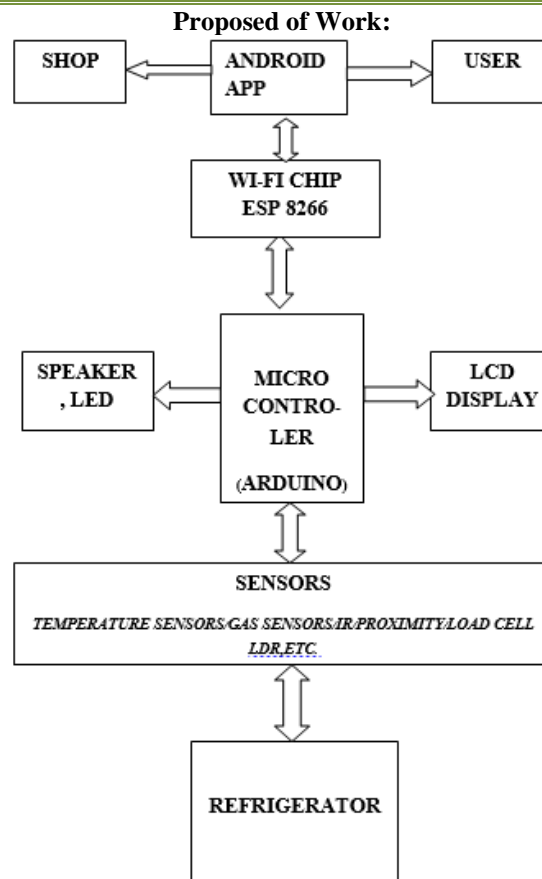


Fig. Block Diagram

Figure shows the systematic block diagram of Smart Refrigerator using arduino ATMEGA 328p controller board. All the sensors used with their functions are shown in block diagram.

As shown in above fig. we have used Aduino as controller to control the process of our project. The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

We are using sensors like Temperature sensor, Load cell, Proximity sensor, Gas sensor, Push buttons which will sense respective parameters and that values will be sent to the Arduino board. Then according to the received values from sensors Arduino will take particular action specified in program stored inside memory of Arduino.

The output devices like LCD, Buzzer are used to display warnings to the user as well as Buzzer will be blown so that user can understand warning from refrigerator. Android app is made for both user as well as shopkeeper. When things go below threshold level that indication will be given to the user's app then user will place the order if necessary. If user places order, then shopkeeper's app will get notification regarding order then he will deliver that product to user's home.

Objectives:

- Provide ON/OFF control through mobile phone.
- Send SMS for items to be order.
- Gives indication when ice is ready.
- Sends alert when smell in fridge exceeds threshold.
- Detects volume of liquid in bottles.
- Gives alert when hot items are placed in refrigerator.
- Save energy by sensing temperature during winter.
- Indication when main door or freezer door is opened for long time.
- Over weight sensor.

- Gives alert on expiry of products in refrigerator.
- Display temperature on front panel.

5. Results:

Now a day's peoples are getting too much busy in their work so they don't have time to remember how much daily required ingredients are there in refrigerator. Our system provides facility that if vegetables or daily essentials like milk, eggs, etc. are below predefined threshold then user will get indication on our app and he will place order to shopkeeper near his house n he will get deliver that particular product. If one piece of vegetable like tomatoes gets rotten then it will cause others to be rotten and if user dint notice this n ate such food it will be harmful for his health. So we will check whether the veg is healthy or not. When rotten veg is detected that indication will be given to user. We had provided facility to indicate whether ice is ready or not? When user puts ice tray inside the fridge once the ice gets ready our system provides indication regarding ice is ready with alarm. When user puts hot item inside refrigerator then load on refrigerator gets increased. So to avoid this we will check for hot item too. When user puts hot item inside refrigerator system will give indication regarding same. We had also provided on/off switch from mobile app. suppose user is out of station for more than 3-4days and he has forgotten to switch off the refrigerator. He can switch off the refrigerator remotely from app just by making the switch off on our app.

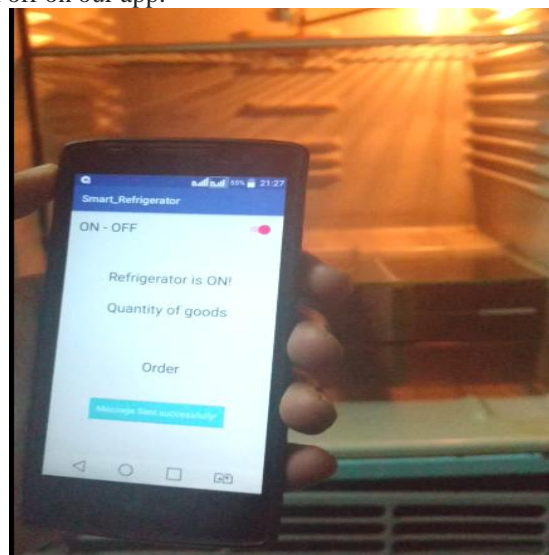


Fig. on-off through android application

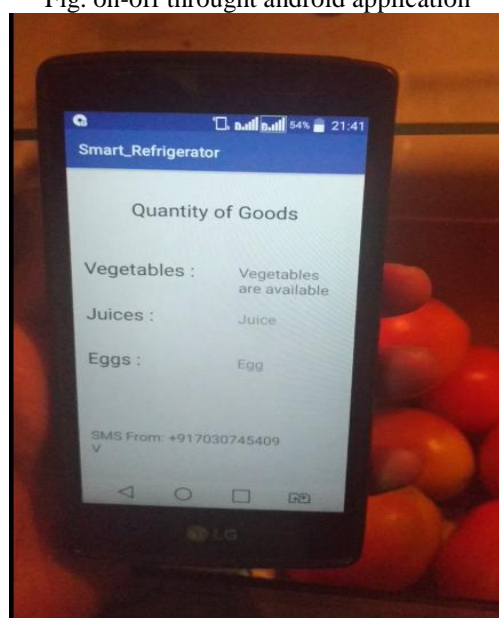


Fig. checking vegetable are available or not on android application.

6. Discussion:

In the previous system they have done data exchange through gsm and was based on SMS. Now a day's peoples are using internet widely so we have used IOT. We are checking the vegetables quality so that human's health can be preserved. When vegetable gets rotten we will give notification on mobile app through internet. With our system we can switch on/off refrigerator remotely. We are checking for whether ice is ready or not. When ice becomes ready then indication for same is given on lcd placed on refrigerator. Our system provides solution for getting load on refrigerator if hot item is placed inside refrigerator.

We will let user know when hot item placed inside refrigerator. If main door of refrigerator is left open it causes outside air to flow inside refrigerator which increases temperature inside refrigerator and which interns increases our power consumption. So when user leaves door open for more than some predefined time we will give notification with alarm so that he can close the door and energy will be saved.

7. CONCLUSION

The Smart Refrigerator module is able to remotely notify the user and control the functions inside the refrigerator. It also facilitates purchase of the scarce food items from an online vendor. The notifications and information inside the application that is sent to the user via android application. This module allows the user to indicate a placed order and the other users to acknowledge the placed order.

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